NEW CROSS SECTION DATA FOR PRODUCTION OF THE THERAPEUTIC RADIONUCLIDES ^{64}Cu, ^{140}Nd AND ^{192}Ir.

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The use of radionuclides in internal radiotherapy is gaining significance. In this regard, radionuclides emitting α-particles, low-energy β-radiation, or conversion and Auger electrons are needed. We investigated the formation of ^{64}Cu, ^{140}Nd and ^{192}Ir via novel routes. The radionuclide ^{64}Cu ($T_{1/2}$ =12.7 h, E_{β^-} = 0.6 MeV, E_{β^+} = 0.7 MeV) is interesting because of its suitable half-life and low energy β-radiation. It has the extra advantage of in-vivo detection via Positron Emission Tomography (PET). The radionuclide ^{140}Nd ($T_{1/2}$ =3.37 d, 100 % EC, no γ-radiation) is almost a pure Auger-electron emitter. The available database for its production is rather weak. The radionuclide ^{192}Ir ($T_{1/2}$ = 78.83 d, E_{β^-} = 0.7 MeV) is well established in therapy. However, since it is commonly produced in a reactor, it is of low specific activity. We report on cross sections of the reactions ^{66}Zn(d,α)^{64}Cu, ^{nat}Ce(^{3}He,xn)^{140}Nd, ^{141}Pr(p,2n)^{140}Nd, and ^{192}Os(p,n)^{192}Ir measured using the stacked-foil technique:

- The ^{66}Zn(d,α)^{64}Cu reaction was studied radiochemically over the energy range of 5 to 14 MeV. The excitation function showed a maximum of about 25 mb at 11 MeV. These are the first measurements on this reaction using highly enriched ^{66}Zn (99.0 %). A comparison of this reaction with the most commonly used production route, namely the (p,n) reaction on highly enriched ^{64}Ni, will be given.

- The ^{nat}Ce(^{3}He,xn)^{140}Nd reaction was studied from 15 to 36 MeV. The disturbing side reactions ^{nat}Ce(^{3}He,xn)^{139m,g,141m,g}Nd were also investigated. A maximum cross section of about 900 mb at 27 MeV was obtained for the ^{nat}Ce(^{3}He,xn)^{140}Nd reaction. The results deduced via direct X-ray counting and measurement of the annihilation radiation of the daughter nuclide ^{140}Pr were compared.

- Measurements on the ^{141}Pr(p,xn)^{140,141m,g}Nd reactions were done from 10 to 45 MeV. The ^{141}Pr(p,2n)^{140}Nd reaction shows a maximum cross section of about 850 mb at 18 MeV. A comparison of the two production routes of ^{140}Nd, viz. ^{nat}Ce(^{3}He,xn)^{140}Nd and ^{141}Pr(p,2n)^{140}Nd reactions, will be presented.

- Measurements on the ^{192}Os(p,n)^{192}Ir reaction are underway using natural and isotopically enriched osmium targets over the proton energy range of 5 to 20 MeV. The shape of the excitation function appears to be similar to that of other (p,n) reactions in this mass region.

Differential and integral yield calculations of the desired radionuclides via the investigated reactions are being performed and the suitability of these reactions for production of the respective therapeutic radionuclide will be discussed.

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